Lloyd's Register

Rules and Regulations for the Classification of a Floating Offshore Installation at a Fixed Location, April 2008

Notice No. 1

Effective Date of Latest Amendments:

See page 1

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RULES AND REGULATIONS FOR THE CLASSIFICATION OF A FLOATING OFFSHORE INSTALLATION AT A FIXED LOCATION, *April 2008*

Notice No. 1

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of a Floating Offshore Installation at a Fixed Location, April 2008.*
The amendments are effective on the dates shown:

Part	***Chapter***	***Section***	***Effective date***
3	2	1, 6, 7, 10	1 March 2012

It will be noted that the amendments also include corrigenda, which are effective from the date of this Notice.

The *Rules and Regulations for the Classification of a Floating Offshore Installation at a Fixed Location, April 2008* are to be read in conjunction with this Notice No. 1. The status of the Rules is now:

Rules for FOIFL	Effective date:	April 2008
Notice No. 1	Effective dates:	1 March 2012

Part 3, Chapter 2

Buoys, Deep Draught Caissons, Turrets and Special Structures

Effective date 1 March 2012

■ *Section 1* General

1.4 Class notations

1.4.9 Vessels designed for offshore loading should have the arrangements for offshore loading designed and constructed in accordance with suitable standards. For vessels classed LR, the requirements are outlined in Pt 7, Ch 6 of the Rules for Ships.

■ *Section 6* Mechanical items

6.2 Design

6.2.1 The design of joint and hinges should minimise any stress concentrations, particularly where significant dynamic loadings may occur.

6.2.2 Suitable strength and fatigue analyses of joint or hinge assemblies are to be carried out, where appropriate.

6.2.3 It is to be considered that vibration levels in the associated pipe work and structure of the swivel are to be kept to a minimum level to avoid bearing-associated failures.

~~6.2~~ 6.3 ~~Loads~~ Bearings

~~6.2.1~~ 6.3.1 Components in swivel support systems are to be designed for the operating forces, moments and pressures intended, taking into account, where necessary, survival, tow out, damaged, fatigue and other operating conditions. Design calculations are to be submitted.

~~6.2.2~~ 6.3.2 ~~Roller~~ Rolling element, pad and journal bearings used in swivel units are to be designed for the static and dynamic loadings which are expected in service. Bearing pressure and fatigue life calculations are to be submitted.

~~*6.2.4* Local water pressure effects on component seals, etc., are to be taken into consideration.~~

~~*6.2.5* Special consideration is to be given to torsional loading effects for the design of universal joints and other connections.~~

~~6.2.3~~ 6.3.3 Bearings, joints, etc., are to be suitable to withstand the application of all loads expected during service life. The maximum design loadings are to be determined in accordance with Pt 4, Ch 3,4.

~~6.3.1~~ 6.3.4 The design of bearings, joints, etc., is to be in accordance with an acceptable design method or an internationally recognised Code or Standard. For acceptable Codes for roller and ball bearings, *see* Appendix A.

~~6.2.6~~ 6.3.5 Bearing design is to include the effects of low and high frequency response loadings, where appropriate.

~~6.2.7~~ 6.3.6 The effects of motions for a range of typical operating modes are to be considered in the design.

~~6.3.4~~ 6.3.7 Where necessary, suitable lubricating arrangements are to be fitted to all adjacent bearing surfaces to maintain an adequate and continuous supply of lubricant to the surfaces during all unattended periods. Gravity-fed or non-power-operated systems are to be preferred for non-manned installations.

~~6.3.5~~ 6.3.8 Consideration is to be given to monitoring turret roller bearings in service by condition monitoring the bearing lubrication fluid. Details to be submitted to LR.

~~6.3.6~~ 6.3.9 Primary bearing surfaces are to be adequately protected from deterioration caused by the ingress of sea-water and other contaminants by a system of seals or other suitable alternative methods. Sealing arrangements for bearing systems are to contain lubrication and are to be designed for their intended service life or field life of the installation, as applicable.

~~6.3.7~~ 6.3.10 ~~Where self-lubricating materials are used, they are to be suitable for the intended use.~~ Data should be submitted to substantiate the fitness of the bearing for the field life of the installation or 20 years, whichever is greater. Consideration will be given to the reduction of this life where an agreed change-out programme is implemented.

~~6.3.10~~ 6.3.11 Classification will be based on a review of the designers' calculations.

6.3.12 In all cases where the bearing dynamic load is more than 50 per cent of the basic load dynamic rating, supporting justification is to be submitted.

6.3.13 The suitability of bearings selected for heavily loaded applications should be checked to ensure that their basic static load rating is adequate, taking into account their static safety factor.

6.3.14 Consideration is to be given to the use of lubricants with EP additives where the bearing loads are high.

6.3.15 Consideration is to be given to rolling element bearings; those which cannot be replaced whilst vessel/buoys are at location are to be designed for L5 bearing life.

6.3.16 Consideration is to be given to ensuring that excessive lubrication is avoided in tilting pad bearings and that the Pressure Velocity is within the recommended limits. For acceptable limits, *see* Appendix A.

6.3.17 Where grease lubrication is being used on a loading buoy bearing, frequent grease sampling and system monitoring are to be considered.

~~6.3~~ 6.4 ~~Design~~ Bearing support structures

~~*6.3.1* The design of bearings, joints, etc., is to be in accordance with an acceptable design method or an internationally recognised Code or Standard. For acceptable Codes for roller and ball bearings, *see* Appendix A.~~

~~*6.3.2*~~ *6.4.1* Bearing support structures are to be assessed for fatigue damage due to cyclic loading in accordance with Pt 4, Ch 6,5.

~~*6.3.3*~~ *6.4.2* Permissible stress levels in supporting structure are to be in accordance with those specified in Pt 4, Ch 6.

~~*6.3.4* Where necessary, suitable lubricating arrangements are to be fitted to all adjacent bearing surfaces to maintain an adequate and continuous supply of lubricant to the surfaces during all unattended periods. Gravity fed or non power-operated systems are to be preferred for non-manned installations.~~

~~*6.3.5* Consideration is to be given to monitoring turret roller bearings in service by condition monitoring the bearing lubrication fluid. Details to be submitted to LR.~~

~~*6.3.6* Primary bearing surfaces are to be adequately protected from deterioration caused by the ingress of sea-water and other contaminants by a system of seals or other suitable alternative methods. Sealing arrangements for bearing systems are to contain lubrication and are to be designed for their intended service life or field life of the installation as applicable.~~

~~*6.3.7* Where self-lubricating materials are used, they are to be suitable for the intended use. Data should be submitted to substantiate the fitness of the bearing for the field life of the installation or 20 years, whichever is greater. Consideration will be given to the reduction of this life where an agreed change-out programme is implemented.~~

~~*6.3.8* The design of joint and hinges should minimise any stress concentrations, particularly where significant dynamic loadings may occur.~~

~~*6.3.9* Suitable strength and fatigue analyses of joint or hinge assemblies are to be carried out, where appropriate.~~

~~*6.3.10* Classification will be based on a review of the designers' calculations.~~

~~*6.3.11*~~ *6.4.3* A fatigue analysis of structural items is to be carried out in accordance with Pt 4, Ch 6,5. Factors of safety on fatigue life are to be determined after consideration of the redundancy of the structure, the accessibility of the item being considered, the consequence of failure, etc. Minimum required factors of safety are given in Pt 4, Ch 6,5.

6.4.4 Consideration is to be given to improve bearing support structure stiffness to prevent substantial increase in the bearing loading.

6.4.5 Consideration is to be given to the integrity of the weld attachments for the support structures.

6.4.6 Cracking of bearing housings at stress concentrators due to bearing wear is common in roller bearings and should be considered as a potential damage mechanism.

~~6.4~~ 6.5 Seals

~~*6.4.1*~~ *6.5.1* Leakage of lubrication fluid and subsequent ingress of sea-water is to be prevented by installing a suitable system of seals.

~~*6.4.2*~~ *6.5.2* The seals employed are to be of a suitable material for the intended service.

~~*6.4.3* In general, failure of a single seal should not result in degradation of the bearing surfaces, etc.~~

~~*6.4.4*~~ *6.5.3* Sealing elements installed are to be capable of safely absorbing the required deflection, or, alternatively, adequate provisions for slippage are to be incorporated in the design.

~~*6.4.5* To assist in the prevention of the ingress of water, consideration is to be given to pressurisation of the lubrication system to give a small positive differential pressure across the seals.~~

~~*6.4.6*~~ *6.5.4* A lubrication leakage detection system is to be installed in order to monitor seal performance in service. The system is to provide early warning of seal deterioration to allow appropriate remedial action to be taken.

6.5.5 Swivels and sections in the swivel stack are to use seal arrangements which shall provide redundancy such that leaks can be detected before process fluid release occurs.

6.5.6 The seal fluid pressure is to be higher than the maximum well shut-in pressure and system surge pressure.

6.5.7 A continuous seal fluid leakage detection system is to be monitored to verify system availability and ensure hydrocarbons are not released. The system is to be fitted with alarms to detect early seal deterioration and allow appropriate remedial action to be taken.

6.5.8 In the event of a secondary seal failure, a production ESD is to be initiated and the leak detection system must be capable of precisely identifying the failed seal.

6.5.9 The supply of barrier seal oil for the swivel stack is to be from a dedicated HPU package with its own control panel and feedback to the main control room.

6.5.10 The seal seats and travelling surfaces should be corrosion-resistant and of sufficient hardness to prevent excessive abrasion and wear.

6.5.11 Care is to be taken to minimise the risk of explosive decompression of seal in the event of a catastrophic failure. Maximum decompression rates for the seal material are to be provided by the manufacturer.

6.5.12 Prevention of contamination to dynamic seals is crucial. Seals are to be fitted with a silt-barrier system to prevent sand or particles getting into the seals, where applicable.

~~6.5~~ 6.6 Bolted joints

~~*6.5.1*~~ *6.6.1* An acceptable method for the determination of flanged bolt loads is to be found in *Verein Deutscher Ingenieure (VDI) 2230 – Systematic Calculation of High Duty Bolted Joints*. Other suitable internationally recognised Codes or Standards may be used.

~~*6.5.2*~~ *6.6.2* For joints subject to fatigue loading, the bolts are to be of ISO 898/1 Material Grade 8.8, 10.9 or 12.9, or equivalent. They are to be pre-tensioned by a controlled means to 70 to 90 per cent of their yield stress. For bolt sizes greater than M30, pre-tensioning must be carried out, in a rational order, by a hydraulic tensioning device.

6.6.3 The torque on all bolting on bearing housing, support structures and attachments is to be regularly inspected and checked. The maintenance plan is to be submitted to LR for review.

~~6.6~~ 6.7 Swivel stack

~~*6.6.1*~~ *6.7.1* The swivel stack is to be designed for the maximum combined operating forces, moments, internal pressures and thermal loading.

~~*6.6.2*~~ *6.7.2* In general, the swivel stack is to be analysed by a three-dimensional finite element method unless agreed otherwise with LR. Design calculations, including details of the model, are to be submitted.

~~*6.6.3*~~ *6.7.3* Permissible stress levels are to be in accordance with a recognised Code or Standard.

~~*6.6.4*~~ *6.7.4* Pressure piping attached to the swivel is to comply with Section 7.

~~*6.2.5*~~ *6.7.5* Special consideration is to be given to torsional loading effects for the design of universal joints and other connections.

6.7.6 The fluid swivel is to be designed to withstand the maximum range of operating conditions, including maximum well shut-in pressure and pressure surge condition.

6.7.7 Torque arms are to be designed to the appropriate load cases in accordance with Pt 4, Ch 3.

■ *Section 7*
Piping and piping systems

7.2 General requirements for piping systems

7.2.6 Instrument control isolation valves are to be in the locked open position.

7.2.7 Flexible hoses are to comply with the requirements of Pt 5, Ch 11,7.

7.2.8 Where valves of the piping systems are arranged for remote control and are power-operated, a secondary means of operating the valves is to be considered.

7.2.9 Watertight compartments are to be provided with power pump suctions for dealing with their drainage. Special attention is to be given to compartments containing equipment which is essential to the safe operation of the installation. The drainage systems are to comply with the requirements of Pt 5, Ch 12.

■ *Section 10*
Swivel testing requirements

10.1 General

10.1.1 Testing procedure should be specified (and agreed with the Owner/Operator) to ensure that casting, forgings and other items used in the fabrication of the fluid swivel system housing are in accordance with the *Rules for the Manufacture, Testing and Certification of Materials*.

10.1.2 Seal designs and materials should be Type Approved by dynamic test which simulates a number of years of service under the conditions and with exposure to fluid representative of the design condition and depressurisation. The number of years of successful service to be proven by testing should be agreed with the Owner/Operator.

10.1.3 The following tests are to be performed on each swivel; however, test procedures should be developed by the manufacturers and approved by the Owner/Operator:
(a) Hydrostatic proof test.
(b) Pressure fluctuation test.
(c) Rapid decompression test (Gas Swivel).
(d) Cyclical loading test.

10.1.4 Full rotation tests in each direction and cyclic partial rotation tests should be performed at all operating pressures. Rotation speeds should model real-time conditions to represent accurately the intended application and also to prevent damage to the seals.

10.1.5 Testing is to be conducted in accordance with an approved test procedure in the presence of a Surveyor. The procedure is to address an acceptable leakage rate.

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